MICROELECTRONICS AND EMPLOYMENT IN PUBLIC ADMINISTRATION: A CASE STUDY IN THREE ONTARIO MUNICIPALITIES

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PREFACE

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EXECUTIVE SUMMARY

The effects of microeletronics and computers on municipal employment were studied in three major Ontario cities. It was found that the use of informatics technologies has aided productivity, and at times led to substantial cost reductions for certain operations. In the departments affected by automation, the number of employees first increased slightly, then levelled off and remained stable later despite sometimes quite substantial increases in workload handled. Displacement rather than unemployment was the rule for municipal employees in the departments which adopted the new technologies. Redundant jobs were usually eliminated by attrition or lateral transfer of affected employees. Overtime work, casual employment, and contracting out were reduced, but no outright terminations of permanent employees were reported.

Effects on occupational and skills composition of employment differed from department to department within the municipal governments studied, according to the character of the new application and the way in which it was imple-implemented. In financial operations, which were transformed by the early phases of computerization, a pattern of employment discontinuity was noted. The result of this process was a widening of the skills gap between the diminishing number of lower skilled clerical jobs and the increasing number of hightly skilled computing, accounting, and other analytical positions. In word processing operations, however, the pattern has been one of retraining existing personnel, and maintenance or even improvement of individual career path continuity over time.

In the years ahead, many of the occupations which have up to now remained relatively removed from earlier phases of informatics are expected to be brought into much closer contact with the new technologies. Besides nearly all clerical and secretarial staff, workers in occupations such as building inspection, draughting, and fire protection may become first hand users as well as recipients of electronic information processing based on mircroelectronics and computer technology. While there is little need to fear that these new applications, any more than the old applications, will in fact result in massive numbers of direct job losses in municipal administrations, the prospects of indirect job losses and of lack of future employment growth is another question entirely. It is nearly universally agreed that in the absence of informatics technologies, municipal employment would have had to expand significantly over observed levels in order just to keep up with increasing demands.

Effects on the quality of the working environment of municipal employees, while not insignificant, are difficult to evaluate comprehensively. Nevertheless, it is clear that health concerns such as those related to possible birth defects and vision problems are subjects preoccupying more than a few city employees and their union representatives, who feel that the evidence for or against the hazards of video display terminations (VDTs) is still inconclusive. Pending satisfactory resolution of these questions in a convincing manner, such fears will inevitably dampen employee and union

enthusiasm for the new technology -- quite apart from any other fears they might have regarding its effects on the quantity and quality of future employment opportunities. In respect to the direct employment effects of the use of microelectronics and computers, union interest is focused on the protection of jobs, salaries and working conditions of current membership. To this end, workers and their representatives require not just notification of changes already under way, but also the opportunity to have input during the planning and design states, so that adequate lead time will be available for any adjustments necessary.

INTRODUCTION

Microelectronics technologies are rapidly diffusing throughout the workplace. In both goods and service producing area tiny silicon chips are becoming as numerous as electric motors and video display screen as commonplace as typewriters and telephones.

Some observers predict that these changes signal the beginning of a microelectronics revolution which may have long run consequences as profound as those of the industrial revolution of the last century. Others point to cases of massive job loss and severe dislocation which have already occurred within particular industries. In addition, important changes have been noted in ways of working, as well as in the educational, skills and occupational composition of the workforce required in the industries being transformed by the new technologies.

Not surprisingly, then, at the same time as the highly developed countries of the Organization for Economic Co-operation and Development (OECD) are increasingly looking to microelectronics as a means of raising labour productivity, concern is also mounting over the potentially adverse effects of these technologies on employment (OECD, 1981; Rada, 1980; Zeman, 1979). While this concern is based on a certain amount of both theoretical and practical evidence, hard data on the employment effects of the use of these technologies are still hard to come by.

Generally speaking, the available statistics are ill-suited to a comprehensive analysis of the employment impacts of microelectronics technologies. Simulation modelling approaches hold some promise (Rahn, 1981; Sinclair, 1981), but these are also hampered by a lack of suitable data on which to base the assumptions and test the results. A case study approach, on the other hand, can answer certain specific questions concerning productivity and employment in particular industries and enterprises.

In Canada, a few case studies of the effects of microelectronics on employment have recently been completed (Menzies, 1981; Peitchinis, 1981), but these relate mostly to applications in the private sector. Thus the conclusion of these studies, based as they are on the impacts of imformation technologies in profit-oriented enterprises, do not necessarily apply with equal force to the results which could be expected in public administration. A priori, the most we can say is that effects on employment should depend at least as much on the way in which the technologies are applied, as on anything inherent in the technolgies themselves. Thus, we must examine the actual experience of public sector users in order to be able to predict with any degree of certainty what may or may not be the likely effects of a continued diffusion of these technologies.

For the purposes of this study, the main subject of examination was required to fall under provincial jurisdiction, employ a high proportion of office workers and women, and be highly unionized. We decided to concentrate our main efforts on the City of Toronto, where the process of computerization was known to be considerably advanced already. Two other

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technologically progressive Ontario cities were also chosen for brief examination -- more as points of comparison for the main subject than as complete case studies in themselves. Since the cities studied were relatively advanced to the implementation of information technologies, it was hoped that their experience could provide an indication of the type of effects other localities might experience at a later date.

Although our sample of cities is no way random, it is reflective of a range of urban size groups. The first and smallest of the three cities examined is Oshawa (population 115,000), a manufacturing, administrative and commercial centre which is home to General Motors of Canada. The second city is Ottawa (population 300,000), a medium-sized metropolitan centre which is the focal point of Ontario's emergent microelectronics industry, as well as capital of Canada's federal government administration. The third city examined is Toronto (population 635,000), the provincial capital and centre of Canada's largest urban area.

Before proceeding with the individual case studies, Chapter One presents a general overview of informatics and employment in Ontario municipalities. First, the pace of the diffusion process is examined, followed by a brief look at the extent of the use of computers and microelectronics for information processing in each of the three cities. A more detailed treatment on a city-by-city basis is presented in Chapters Two, Three and Four. Chapter Five examines the wider context of microelectronics in public administration, including related employment trends by occupational category. Chapter Six summarizes the findings of this study in terms of what has been observed to date and the outlook for the future.

CHAPTER ONE

OVERVIEW OF INFORMATICS TECHNOLOGY AND EMPLOYMENT IN ONTARIO

Computer Usage in Ontario Municipalities

According to surveys done by the Municipal Affairs Branch of the Ministry of Intergovernmental Affairs (see Figure 1.1 and Table 1.1), the number of municipal computer installations in Ontario has grown from 11 in 1968 to an estimated 140 in 1981, and may rise to a projected 280 installations by 1985. It should be noted that mere possession of, or access to, a computer installation tells us nothing about the number of different application areas in which the technology is being utilized. Nevertheless, it does indicate that the municipality has at least taken the first step in the direction of computerizing its operations.

The vast majority of municipalities with population over 25,000 now possess at least some sort of computer facility, and many of the others are known to be using computers via service bureaux. In 1980 there were 156 municipalities in this size category and they accounted for 80 per cent of the province's total population. In the under 25,000 population category, we find 692 lower-tier municipalities taking in 20 per cent of the Ontario population. Most of these small municipalities are still doing without computer installations of their own, although perhaps as many as half are making use of outside computer service bureaux for tax billing purposes. While these hundreds of small municipalities probably represent a sizeable market for sales of micro-computer equipment, it is quite doubtful if the new technology could have much of an effect on their employment volumes, which are quite small in any case.

Statistics such as these give a fair representation of the extent of numerical data processing, but they tell little about the diffusion of word processing applications and equipment. Word processing in municipal governments was introduced by Toronto in 1975, nearly 15 years after their first computer installation. Within five years, word processing had begun to spread to other large cities, with the diffusion process accelerating markedly in 1979 and 1980. For many reasons, including the much lower initial prices and the minimal requirements for specialized technical or professional staff to program, operate and maintain the equipment, the diffusion of word processing in Ontario municipalities is expected to be much more rapid than was the case for data processing computers. There is also no compelling reason why even the smallest municipalities could not benefit from this more accessible technology - but once again, it is hard to see how this could have much effect on employment volumes in such small towns and villages. In the larger municipalities, however, the effects of a continued rapid diffusion of word processing, in terms of both quantity and quality of employment, will depend in large part on the way in which the new technology is introduced, organized, and utilized. Later sections of this report will compare the results to date in Toronto, Ottawa and Oshawa against those of business users across the United States.

Information Technology and Employment in Toronto, Ottawa and Oshawa

Table 1.2 provides an overview of informatics technology and employment in the three cities which are the subjects of our case studies. In terms of electronic data processing (EDP) applications, Toronto took the lead, only this time the other two cities were only four years behind. Nevertheless, Toronto is still far out front in terms of the extensiveness of the diffusion of this technology, with over five times as many trained word processing operators per 1,000 employees as Ottawa, and nearly twice as many as Oshawa.

In terms of word processing (WP) applications, Toronto again took the lead, only this time the other two cities were only four years behind. Nevertheless, Toronto is still far out front in terms of the extensiveness of the diffusion of this technology, with over five times as many trained word processing operators per 1,000 employees as Ottawa, and nearly twice as many as Oshawa.

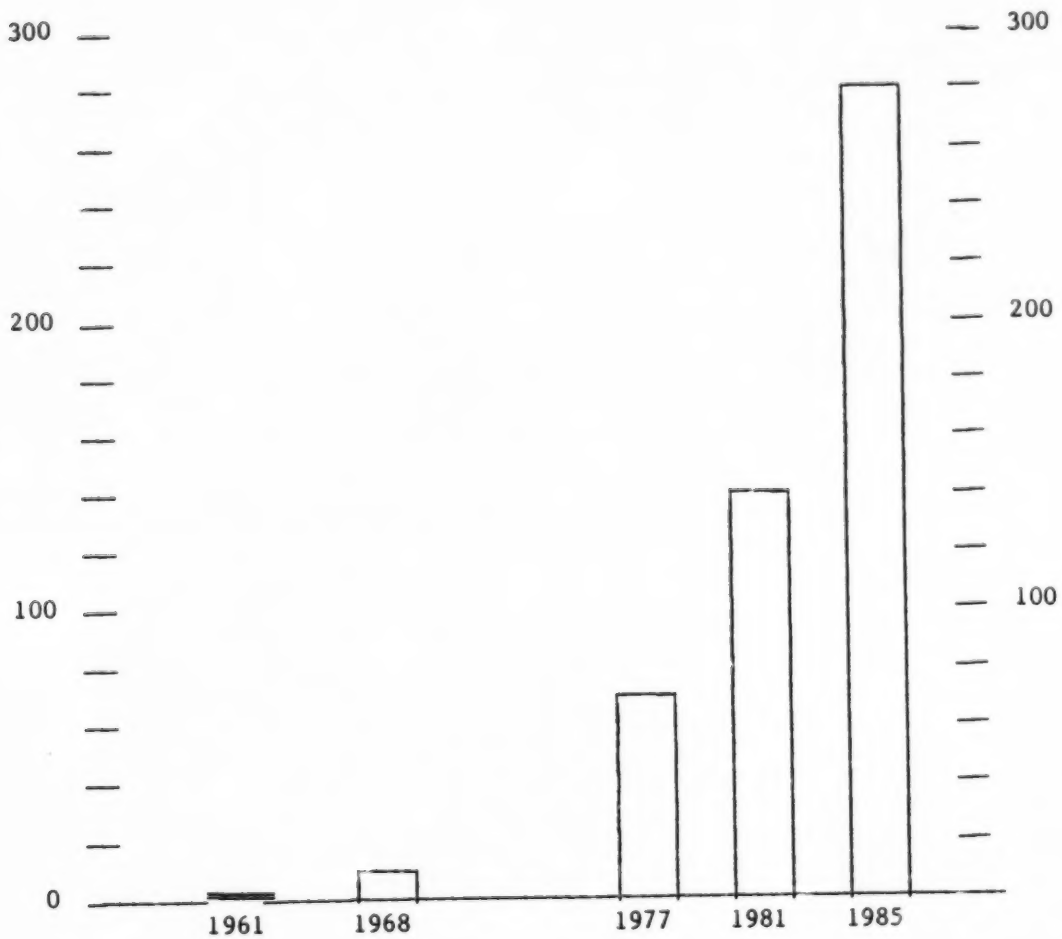
While these indicators are obviously crude, they do provide a comparative framework to help situate the more detailed discussions to follow. In addition, they provide a first indication of the distance still to be travelled before informatics technologies can be considered to be completely diffused throughout the city departments. For example, when we see that in Toronto there are at least 18 employees per terminal (or less than half that number if only office employees are considered), it is clear that the potential utility of these systems must be far from fully realized. To put these figures in perspective, some experts consider three employees per terminal to be the word processing saturation point.

Figure 1.1

MUNICIPAL COMPUTER INSTALLATIONS

ONTARIO, 1961-1981,

WITH PROJECTION TO 1985



Source: See Table 1.1.

For a general discussion of computer usage in Ontario local government, see Steen (1980).

Table 1.1

MUNICIPAL COMPUTERIZATION, ONTARIO, 1968-1981, WITH PROJECTION TO 1985

Year	Number with computer installation	Number with other access to computer processing
1968	11	50[a]
1977	75	300[b]
1981	140 (estimated)	--
1985	280 (projected)	--

Note: a. Service bureau usage for tax purposes.

b. Mostly service bureau usage for tax purposes (200), plus municipalities with access to other public or parapublic computer centre (100).

Source: Data for 1968 from an unpublished survey conducted by the Department of Municipal Affairs; data for 1977 from an unpublished survey conducted by the Municipal Affairs Branch, Ministry of Municipal Affairs; estimates for 1981 and projections to 1985 by Dennis Steen of the Municipal Affairs Branch, Ministry of Intergovernmental Affairs.

Table 1.2

INFORMATICS TECHNOLOGY AND EMPLOYMENT IN THREE ONTARIO CITIES, 1980

	Toronto	Ottawa	Oshawa
City data			
Population	635,000[a]	300,000[a]	115,000[a]
City employees	5,457[b]	2,130[c]	709
City employees/1,000 population	8.9	7.1	6.1
Electronic data processing (EDP) applications			
First computer installation	1961[e]	1967[e]	1972[f]
Computer and systems staff	60[g]	30[g]	13[g]
Computer and systems staff/1,000 employees	11	14	18
Data processing terminals	240[h]	25[i]	14
City employees/data processing terminal	23	85	51
Word Processing (WP) applications			
First word processing application or equipment	1975	1979	1979
Word processing operators	200	15	12(est.)
Word processing operators/1,000 employees	37	7	17
Word processing terminals	60[j]	13[k]	8[l]
City employees/word processing terminal	91[m]	164	89
All informatics applications			
EDP and/or WP terminals	300	38	19
City employees per EDP and/or WP terminal	18	56	37

Table 1.2 (Cont'd.)

Notes:

a. Estimates for 1979 from the Ontario Municipal Directory (Ministry of Intergovernmental Affairs, 1980).

b. Including public health department, which falls under regional jurisdiction in the other two cities.

c. Excluding police.

d. Excluding public health department, there were 7.8 city employees per 1,000 population in the City of Toronto.

e. No computer usage via service bureaux before that time.

f. Usage of computers via service bureaux began in 1970.

g. Staff attached to the computer services division only.

h. All terminals can be used for both data and word processing applications; this figure excludes 60 terminals used mostly for word processing applications, but includes 25 hand-held data entry terminals used by water meter readers.

i. Not counting 50 patrol car-mounted and 15 office-installed terminals in the police department.

j. Number of general purpose video display terminals used mainly for word processing applications; at any moment during the day, a maximum of 40 operators are inputting text into the system via ATMS.

k. Including one terminal also used frequently for data processing applications.

l. Not including one microcomputer which is used for both data and word processing applications.

m. Based on terminals used mainly for word processing applications.

CHAPTER TWO

INFORMATICS TECHNOLOGY AND EMPLOYMENT IN A SMALL METROPOLITAN CENTRE: OSHAWA

In the City of Oshawa, computer usage began in 1970 with the signing of service bureau contracts for payroll, tax, and other financial applications. In this respect, Oshawa was similar to most Ontario municipalities, with first exposure to computers for the processing of tax assessment and payroll data, usually via service bureaux operated by one of the banks or computer companies. This initial indirect computerization was accompanied by a concerted effort to systematize and rationalize all city functions, a process which led to the establishment of an interdepartmental computer committee charged with setting priorities and overseeing a long-term (five-year) plan for the introduction and use of electronic data processing in the city.

Data Processing Applications

After the city's first in-house computer was installed in 1972 usage increased rapidly, beginning with "bread and butter" financial applications for all departments, later moving into operational support applications such as maintenance management, cost accounting, contract surveillance and so forth, and recently into more exotic applications such as simulation programming for optimizing the location of fire stations. After an initial upgrading of the original equipment in 1975, the city's present main-frame computer was installed in 1979, and the system is now supporting literally dozens of different applications and includes 11 remote terminals serving all major city departments. In addition to the central computer, the Finance Department also uses a dedicated microcomputer for financial analysis and some word processing applications. Word processing units, in the form of non-communicating, stand-alone equipment, began to be installed by the various departments in 1978; the city now counts eight of these, all produced by the same manufacturer.

In the initial phases of implementation the most tangible benefit of in-house computerization was in the form of cost savings due to the cancellation of the outside computer service contracts worth $43,000 annually at that time. The real benefits, however, were to come later, as new applications were added at relatively little additional cost based on the city's newly developing expertise in municipal data processing, and greater use of previously excess machine capacity.

The net effect on employment in the affected departments was initially positive in the early phases of computerization, as new specialized personnel were engaged to program, operate, and feed data into the automated equipment. Later, however, the inherent potential of the computerized systems to absorb increased workload without commensurateincreases in staffing began to pay off for the city. In fact, although the city's population grew by 26 per cent during the 1970s -- increasing by an average of 2,500 new residents annually -- overall city employment grew by but four

per cent, after the effects of regionalization are taken into account (City of Oshawa, 1971, 1976, 1981).

But this modest expansion in overall employment, even when examined on the departmental level rather than on a city-wide basis, masks some quite significant shifts in occupational structure and skill requirements within the city administration. As lower-level clerical positions became vacant through attrition, these positions have tended to be upgraded to job classifications requiring more sophisticated analysis and interpretation, rather than just a mechanical handling of information.

Changes in productivity attributable to use of the new technology have been observed in several areas of the municipal administration. The most striking examples of labour productivity increases seem to concern those procedures which were computerized the earliest. For example, in the Finance Department, the city's automated tax billing and cash processing now employs 12 people to handle tax accounts relating to 40,000 properties, whereas formerly 16 people had been required to handle the accounts of 23,000 properties. In terms of account processed per employee in this section, the productivity of the remaining workers has more than doubled.

What happened to the four workers whose relatively low-skilled clerical positions were eliminated in the process? Three of the affected people were already scheduled for retirement, and did so, while the other one was transferred to related duties elsewhere in the city hall. In their place, the department hired two more highly skilled workers -- one analyst and one programmer.

Overall employment in the department did not decrease, however, since the decline in employment in the lower clerical ranks was seen as an opportunity to upgrade the organization by adding functions and services previously unknown to the city. For example, over the course of the decade which has passed since the City of Oshawa acquired its own computer, a total of five positions in financial analysis have been created. Two of those positions were filled by retraining former clerks already employed by the city, while the other three were filled by outside hirings. As a result, neither layoffs nor reductions in the number of available jobs have occurred. Indirectly, however, computerization did affect employment, as the number of new jobs created was less than it otherwise would have been. (This increasingly common situation is coming to be described as "jobless growth", which is characterized by expanding output associated with relatively stable or declining levels of employment.)

In a similar manner, the occupational structure of the City Planning Department has also been upgraded. As relatively low-level clerical workers leave, their job descriptions are rewritten and the new positions filled with more highly-skilled professional and technically-oriented people. Recently, the introduction of word processing units in this department has also begun to affect the secretarial side of clerical work.

In the Public Works Department -- another heavy user of computerized systems -- the capabilities of the central computer are now used for a

multitude of applications related to cost control, contract surveillance, budget preparation and fleet maintenance.

Undoubtedly, the biggest savings realized recently as a result of computer usage relates to simulation programming for optimizing fire station locations. This sophisticated modelling exercise is credited with having permitted some very appreciable material and labour cost savings, in that it was found that the building and staffing of a fifth fire station would be unnecessary as long as the locations of two or three of the existing stations were changed. This done, net savings on the order of $5 million were realized -- quite a considerable sum of money in a city of 115,000 inhabitants. At the same time, it is claimed that the quality of service provided, in terms of response time to alarms, has measurably improved over what it was in the former configuration, and over what it was calculated to be if a fifth station had indeed been built.

Word Processing Applications

Electronic word processing in Oshawa began only recently and has yet to have any noticeable effect on employment volumes. Since 1978 several city departments have acquired stand-alone word processing units for their own use. Compatible equipment from the same manufacturer is being used in order to ensure that the floppy disc storage devices can be interchanged and that the clerical personnel who have learned to operate the equipment can be transferred more easily. Communications capability could be added to the existing word processing units, but this potential is not currently being exploited. An evaluative review of the city's experience with electronic word processing is scheduled for 1982.

Planning for new uses of computers and microelectronics is an ongoing process in municipal administration. A number of future applications are planned for the next few years or already under development in Oshawa. They include working towards long range objectives such as a comprehensive records management system, an urban information system, a street inventory system, and a tax cash system. The last of these, by the use of point-of-sale (POS) terminals rather than ordinary cash registers, would eliminate the present separate data entry operation. Short-term objectives include the development of systems for handling leased parking, business licensing, traffic monitoring, fleet maintenance, fire fighting dispatch, personnel records and on-line inquiries, local improvements, municipal elections, and public library finances.

CHAPTER THREE

INFORMATICS TECHNOLOGY AND EMPLOYMENT IN A MEDIUM-SIZED CITY: OTTAWA

The City of Ottawa acquired its first computer in 1967 -- five years before Oshawa, but six years after Toronto. Of a total of 2,130 municipal employees, excluding police, 30 are computer and systems staff. The city uses a high capacity central computer, plus several mini-computers located at the sites of the user departments' offices (which are scattered throughout the city). The mini-computers communicate with the central computer and with each other. Shared logic word processing operations are performed via terminals connected to the mini-computers. In this respect, the approach to computerization taken in Ottawa differs from the approach in the other two cities examined in this study.

When compared to toal municipal employment, Ottawa has proportionately fewer computer people than Oshawa, but more than Toronto (14, 18, and 11 per 1,000 employees, respectively). Each data and word processing terminal must be shared among more employees in Ottawa than in Oshawa or Toronto (there are 56, 37, and 18 city employees per terminal in each of those cities, respectively).

Data Processing Applications

The city's first mini-computer was acquired in 1974 in order to allow replacement of obsolete unit record cards and keypunch equipment by modern electronic direct data entry terminals. The data entry operation itself remained centralized at the Computer Services Division of the Finance Department until 1974, after which six of the 14 central staff were transferred to the departments whose data entry needs they served. By early 1981 the city had a total of six mini-computers, which were used for word processing and Personnel Department uses as well as for the original data entry operation.

In Ottawa, the Police Department is more closely integrated on an everyday basis with the city administration than are departments elsewhere in the province. As a result, the City of Ottawa's Computer Services Division assisted in developing the Ottawa Police computer system known as CADRE. This system includes a network of 50 patrol-car mounted computer terminals, plus 15 terminals installed at police offices. The CADRE system puts the officers on patrol into direct contact with the Police Department's own central computer and through it into almost instantaneous contact with the central files of the Ontario Provincial Police (OPP) and the Royal Canadian Mounted Police (RCMP). (This is clearly a very different and much more sophisticated use for remote terminals than the relatively simple applications for which water meter readers in Toronto, for example, are using their hand-held remote data entry terminals.) Since many intermediary persons and manual operations are no longer necessary under the new system, the effect on office work must have been appreciable. For the officers on patrol, however, the main effect has probably been faster service and less

time spent talking on the radio. Routine calls for a license plate check, for example, can now be made automatically just by keying in the plate number. This has resulted in safer as well as more efficient work for the officers using the system.

Word Processing Applications

The City of Ottawa's approach to word processing differs from Oshawa's in that shared logic, rather than stand-alone units are employed. Furthermore, Ottawa's units communicate with each other. Ottawa's approach to word processing also differs from that of Toronto insofar as Ottawa's installations were cost justified to City Council on the basis of promised employment reductions, whereas Toronto's installations were justified on the basis of savings which could result from reduced typesetting charges.

Two other elements of the Ottawa approach to word processing are also unique among the three cities studied. First, there is a union representative attached to the Word Processing Steering Committee set up by Council to supervise the phased implementation of the system, as the union was understandably reluctant to support the projects as they were originally proposed. Second, most of Ottawa's word processing operators use their equipment on a full-time basis, rather than for just a short period each day. They are in fact specialists in word processing, typically drawn from the ranks of pre-existing typing pools, rather than general purpose secretaries who have simply learned an additional skill to be used on relatively infrequent occasions.

Training of word processing operators in Ottawa is done by the manufacturer's representative. It consists of three full days of instruction, preceded by several hours of self-study by the prospective trainees. All trainees have been stenos or typists already employed by the city. Of the 18 operators who have gone through training since word processing operations in the city began in late 1979, 13 are still using their skills for the city. Of the other five, two have resigned, and three others are no longer using their new skills. Only one of the trainees, however was unable to adjust to the new system, and went back to regular typing after a six-month trial period. Over two-thirds of the active operators (nine out of 13) are using the system on a full-time basis.

Immediately following the initial three-day training period given by the manufacturer, marked increases in typing productivity are generally noted for straightforward business correspondence purposes, but it takes from three to six months to master the techniques of preparing more complex documents.

The original cost-justification for the word processing installations was to the effect that, for every word processing screen added, there would ensue, following a six-month learning period, a net reduction of one clerical position in the department, either through transfer or attrition. It was also expected that savings could be made by selling or terminating leases on typewriters which would no longer be required. In fact, however, although several positions have been identified for eventual elimination,

up to the present, only additions to staff have resulted (starting with a full-time Word Processing Coordinator to supervise the project), and no typewriters have been sold off, despite decreased usage.

This in no way means, however, that productivity increases have not been realized by the word processing operators. On the contrary, detailed 10-day typing surveys, repreated at intervals of several months, show that quite impressive gains in productivity have indeed been recorded.

The results of these surveys show that a typist on a regular machine typically turns out about 15 good pages a day. By contrast, a word processing operator working on a video display screen averages 30 pages a day if the material is all new, 65 pages a day with an even mix of old and new material, and up to 120 pages a day if two-thirds of the material is previously entered material needing correction or changes, and one-third is new material.

In one department which had a dedicated full-time word processing unit as well as a regular typing unit, the regular typists averaged two pages per hour (and three-quarters of their work was original material, rather than retyping), while the word processing operators were turning out over 10 pages in the same time (with 27% original material). The 10-day log showed that, on the average, the word processing operators were actually working at their screens about four hours per day.

The high productivity of the word processing unit in this department also appears to have a substantial impact on the amount of typing required of departmental secretaries (as opposed to typists). As the word processing unit has taken on more workload, the typing workload of the secretaries has decreased to a small fraction of its former level (from 800 to 100 pages) over the eighteen months since electronic word processing was introduced in that department.

At present, the City of Ottawa has 13 active word processing operators. Future plans for word processing in Ottawa call for 15 more operators in four different departments to be trained over the next year and a half.

It is hoped that by the end of 1981, greater use of the new technology will lead to the elimination of the current need for retyping of documents prior to their publication by the city. If this in fact is achieved, the savings to the city should be substantial.

The following sections will examine the employment effects of microelectronics and computer technology on the municipal administration of Ontario's largest city: Toronto. First the focus will be on the earlier uses of electronic data processing for financial applications, and then the focus will shift to the newer uses of informatics technology as an aid to text processing at City Hall.

CHAPTER FOUR

INFORMATICS TECHNOLOGY AND EMPLOYMENT IN A LARGE CITY: TORONTO

The City of Toronto was and continues to be a pioneer in computer usage among Ontario municipalities. Since its first computer was installed in 1961, the City of Toronto has been recognized as a North American leader in electronic data processing. Since 1975, the city has also been a leader in the application of computer technology to word processing and text retrieval operations. These applications now extend to nearly every department and division of city operations, and are used by the City Clerk's department for the production of computer typeset pages for the city's voluminous bi-weekly council minutes.

The Corporation of the City of Toronto, as it is officially known, is a highly diversified conglomerate of largely autonomous departments having relatively little in common other than their connection to the corporate structure of the city. A breakdown of city employment by occupational category shows that the city employs nearly 5,500 permanent staff, of whom only about one-third are office workers, and thus of particular concern to this study. The others are employed in such diverse categories as transportation and motor freight (380), packaging and materials handling (600), public utilities (100), forestry (60), mechanics (80), road work (250), inspection (400), firefighting (1,250), and public health nursing (300). All of those except nursing are, in practice, predominately or even exclusively male occupations. The office occupations, on the other hand, include slightly more women (900) than men (810).

All of the major departments have a substantial number of office workers. In terms of percentage of total employees in office work, however, the city's 16 departments fall into two very distinct classes: those in which the overwhelming majority (85% or more) of total personnel is office staff, and those with substantially less than half of total personnel in office occupations. Although the first group ofdepartments accounts for only 25 per cent of the city's total employment, it takes in 65 per cent of all office employees. It is on this group of highly "bureaucratized" departments where we will focus our detailed examinations. Nevertheless, we should not overlook the importance of microelectronics and computer-based systems on the other group of departments, where office staff form but a small part of total employment. Indeed, it became obvious during this study that the latter group of departments were major users of computer systems as well as major employers of outside workers.

Among municipal departments primarily engaged in administrative activities, the Department of Finance is invariably the largest user of computer services. It was also the first department to computerize its operations, and so, not surprisingly, it is also the department under whose jurisdiction computer services fall (unless a management services department has since been created to handle such central administrative functions). The following section looks at some of the employment effects of electronic data processing in the Finance Department of the City of Toronto.

DATA PROCESSING IN THE FINANCE DEPARTMENT

Municipal computer usage at the City of Toronto first began because of Finance Department requirements and, in terms of machine time, 35 per cent of the city's total computer usage is still devoted to Finance Department purposes. In addition, one-quarter of the city's computer terminals are located in this department. In the Finance Department as a whole, 75-80 per cent of all financial transactions are now computerized. In fact, the only manual processing still performed relate to minor miscellaneous transactions such as the issuing of area licenses for overnight parking. It should therefore come as no surprise to find that the effects of computer and microelectronics on productivity and employment have also been most dramatic in this department.

Eight out of every 10 jobs are classified as clerical in nature in the Finance Department. Of these, 130 jobs, or nearly three-quarters of all clerical workers in the department, are classified as "computing and account recording clerks," as opposed to steno-typists, receptionists, or file clerks. Moreover, the Finance Department accounts for nearly half of all such jobs in the city (City of Toronto, 1980). Since computing and account recording operations are exactly what business computers were developed to do, the Finance Department is clearly the most important city department to consider as far as the effects of electronic data processing on office occupations are concerned.

Tax Billing Automation

In the early 1960s, before the advent of computerized electronic data processing in the Finance Department, it took 60 clerks and supervisors working five months to prepare the annual tax bills. This work now takes two people and the computer a single weekend, and the whole operation is repeated eight times a year. Thus, the labour intensity of the operation of issuing the tax bills was reduced to a small fraction of its former level, but the resultant savings, impressive as they were, did not translate into net job losses.

For one thing, as the tax billing frequency increased, the total number of transactions to be handled (which includes far more than simply issuing the bills) was doubled with each additional billing, but the efficiency of the collection process could not be increased to the same extent. In addition, a substantial amount of indirect labour input was initially necessary to analyse the systems and write the programs needed to automate the billing -- although once these developments were completed only program maintenance was needed to keep the systems running. At that time, the Computer Services Division was also part of the Finance Department. As a result, the total number of Finance Department staff remained stable rather than decreased, but the character of the work performed and the occupational composition of the Department's workforce began to change.

While the automation of tax billing was never intended to cost-justify itself on the basis of staff reduction alone, it is credited with some very

Table 4.1

FINANCE DEPARTMENT AND COMPUTER SERVICES DIVISION EMPLOYMENT,[a] CITY OF TORONTO, 1970 AND 1980

Year	Accounting Division	Treasury Division	Computer Services Division	Miscellaneous	Total	Total Less Computer Services
1970	69[b]	163	48[c]	11	291	243
1980	57	161	60[d]	10	288	228
1970-80	-12	-2	+12	-1	-3	-15
1970-80	-17.4%	-1.2%	+25.0%	-9.1%	-1.0%	-6.2%

Note: a. Permanent establishment as shown in civic organization manuals.

b. Refers to the Accounting Division of the former Budgets and Accounts Department.

c. Refers to the Organization and Methods Division of the Finance Department.

d. Now part of the Management Services Department; the 1980 figure does not include several management consultants who were formerly part of the Organization and Methods Division.

Source: City of Toronto (1980, 1970).

substantial financial advantages for the city, even though these have little if anything to do with staffing levels. Because the city's cash flow is now so much more rapid the city no longer has to borrow enormous sums just to cover the costs of its current operations; instead, the city earns considerable amounts of interest income on the short-term loans it is now able to make from temporary cash surpluses. In fact, the interest earned on these loans is equal to twice the total staff, hardware and materials cost of the computerized systems which made this financial turn-around possible. In this particular case, the net benefits to the city could hardly be more clear.

Other Applications in the Finance Department

Besides property tax billing and collection systems, other computer applications in the Department of Finance now include nearly every operation which formerly was highly labour intensive. The list of uses is very long and includes such things as payrolls, accounts payable and receivable, general ledger, water and sewer acccounts, pension funds, homeowner loans, and investment analysis.

In addition to the many data processing applications mentioned previously, it should be noted that a number of Finance Department applications make use of a central data bank for electronic filing purposes where the computer is used for records consultation and updating, rather than calculations. Although not the creation of the Finance Department at its inception, access to the city's Central Property File, which includes all tax, assessment, inspection and other information relative to each street address, has been an invaluable aid to Finance Department operations. On-line use of the Central Property File also greatly facilitates the work of many other departments and divisions, such as Public Works, Planning, and Health Inspection, which at one time or another all need access to the records pertaining to properties. The central file is thus always up-to-date and available to users anywhere in the city administration, including those in remote site offices far from city hall.

A recent development still considered experimental, but apparently quite successful, has been the use of 25 portable hand-held data entry devices by Finance Department meter readers. Following the principle of capturing data as close as possible to its source, this new development has completely eliminated the former keypunch or data entry operation which consisted of tranferring the water meter figures from paper to electronic medium. This development is analogous to that which is now occurring in the banks, where tellers enter customers' transactions into the central computer directly at the wicket, rather than manually recording and later transferring this to electronic form in a separate data entry operation at the end of the day. The only difference is that information recorded is stored in the meter reader's hand-held device until he or she returns to the office and plugs the unit into a specially equipped terminal which allows the computer to read automatiically the day's results and print out a hard copy duplicate as confirmation.

Should the experiment with the meter readers prove successful, the use of hand-held units for on-site data entry could rapidly be extended to another 75 building and health inspectors whose work would seem to be adaptable to this sort of automation, thus eliminating still more of the present office-based data entry operation. Eventually, such developments would reduce the overall number of specialized data entry operators. Thus, the keypunch jobs which were the hallmark of the first phases of computerization would eventually be phased out.

Effects on Employment

Rare indeed today is the complete transaction which can be handled by the Finance Department without passing through the computer at some stage along the way. Not surprisingly, the transformation from manual to electronic methods of handling information has had a number of very important effects on departmental employment -- and these effects are qualitative as well as quantitative.

Table 4.1 gives the details of employment in what is now the Finance Department and the Computer Services Division of the Management Services Department. Note that the Accounting Division was part of another department in 1970, but has been added to the Finance Department figures for that year in order to make the two sets of numbers comparable. In 1980 as in 1970, the Accounting, Treasury and Computer Services divisions together employed a total of approximately 290 persons. However, while Computer Services gained 12 positions during the decade, Accounting and Treasury lost 15.

If net decreases in overall employment have not been very great, this results only because the total number of financial transactions handled has increased by a factor of eight since computerized processing was first introduced to the department. In addition, while overtime work is still required at seasonal peaks, there has been a marked reduction in the amount of overtime and casual labour employed to handle such peak loads. This sort of change has a beneficial effect on the city treasury, but does not show up in the count of permanent regular employees in the official city establishment tables. Thus, the employment effects, as seen only on that level, will tend to understate the total effects at all levels.

While it is extremely difficult to project what would have happened to levels of employment without the introduction of the new technologyand processes, one official in the department estimates that in the absence of electronic data processing it would now take at least three times the present number of staff to perform the same work done today with the aid of the computer.

Through automation of Finance Department operations the labour intensity of each computerized application has been reduced to a fraction of former levels and has permitted growth in output without commensurate increases in staffing. The work of lower-level clerks, when not eliminated entirely, has been radically altered--some would say deskilled--by these systems, while the work remaining for higher-level clerks now requires more advanced

analytical and accounting skills. An examination of changes in the educational requirements of Finance Department employees from 1970-1980 reveals a marked increase in the amount of formal education required of higher-level clerical workers and their immediate supervisors, as well as profound changes in the way routine tasks are handled by lower-level clerks.

The only departmental educational requirement in 1970 was completion of secondary school or equivalent attainment. By 1980, many clerical positions required considerable advanced training at the post-secondary level. In the Accounting Division, where the upgrading effect has been most obvious, only three positions (all secretarial) out of 57 total positions in the department now require less than a completed first year of accounting studies (CGA/RIA), while no less than 20 positions require at least third, fourth or fifth year. Simultaneous with this substantial upgrading of educational requirements, from 1970 to 1980 total employment in the Accounting Division decreased by 12 while workload handled actually increased due to the introduction of new programs and reporting requirements.

However, in the Treasury Division of the Finance Department which handles the routine day-to-day processing of tax accounts (such as billing and collection of property taxes, water and sewer levies) the most striking effects of computerization relate not so much to the educational requirements of the workforce as they do to the simplification and automation of most of the routine tasks formerly associated with this kind of work. Video display screens plus disc and tape storage have now largely replaced paper, pencil, and voluminous files and ledger books. A casual glance at the tax office on the first floor of the new City Hall is all that it takes to appreciate the extent of this transformation.

The ability to use the computer terminals to call up files and record information is now an essential part of nearly every non-secretarial clerical job in the Department. In addition, as will be demonstrated in later sections of this report, even the previously untouched secretarial work is now modified by computer-based word processing. The story of that transformation, however, will be told in relation to the work of the City Clerk's Department where automated text processing was originally introduced at City Hall.

WORD PROCESSING IN THE CITY CLERK'S DEPARTMENT

Computerized word processing in the Toronto civic administration began in 1975 and centered initially on the needs of the City Clerk's Department to handle large volumes of text. In addition to having begun four years earlier than word processing in Ottawa or Oshawa, Toronto' word processing system differs from the others in terms of both design objectives and technology employed. While Oshawa has chosen stand-alone units employed much like any other office equipment, and Ottawa has chosen shared-logic word processing based on intercommunicating mini-computers in an attempt to cut the number of staff required, Toronto has taken a completely different approach and has achieved very different results from that noted up to this time in the other cities.

The City of Toronto's Approach to Word Processing

The City of Toronto's approach was designed to exploit an already very extensive network of remote terminals that are connected to each other through the big central computer in the newly-formed Management Services Department. From the very beginning, integration of the various elements of the system was seen as essential. The same terminals used for data processing would be used for word processing as well. The communications capability of the terminals would be employed both for the transmission of documents between departments and for text retrieval and access to central data banks. Text entry, like data entry in the financial operations already computerized, would be done only once and as near to the source as possible.

This would mean that text entered in departmental correspondence might eventually appear in the published minutes of City Council or one of its committees without having to be re-entered in a separate typesetting operation. While the savings in duplicated effort and fees to outside printers would be considerable if all went well, there were many pieces which had to come together before the system could function as designed.

First of all, secretaries and typists in each of the 16 departments would have to be trained to operate the word processing systems, implying a substantial commitment to this yet unproven effort - about two weeks of half-day sessions per operator trained. There was never any question of hiring already trained operators from outside. This was 1975 when word processing was still relatively new and there was no pool of operators already trained on the rather difficult word processing systems chosen. In addition, other personnel would have to be trained to operate the in-house phototypesetting equipment to be acquired. This would only affect the City Clerk's department which would be responsible for the typesetting operation, even though other departments would eventually make use of the new system.

By early 1981 the word processing training operation (including one full-time training officer, assisted by several unofficial instructors in departments making greatest use of the systems) had produced some three hundred twenty trained operators of whom 190 are still active users of their new skills. Of the others, over the six-year period since training began about 100 have left city employment and 20 have moved on to other jobs in the civic administration not requiring the use of their word processing skills on a day-to-day basis.

This means that the turnover rate of word processing operators has averaged roughtly 10 per cent annually, or about half the normal rate of attrition for clerical employees generally. Part of the apparently low turnover of city employees with these skills is undoubtedly related to the fact that a certain amount of pre-selection of employees sent for training occurred within the departments, although other factors are also of importance as noted below.

Word processing in most departments of the City of Toronto has been seen as an additional skill to be added to those already possessed by clerical

workers, rather than as a specialized full-time occupation which would be more akin to keypunching than traditional secretarial work. As a result, wholesale restructuring of workflows and duties has not been necessary and word processing training has often been an occasion for the upgrading of secretarial work, rather than for its deskilling.

No salary increment goes with completion of training in basic word processing operations, but clerical workers possessing word processing skills have been in high demand at City Hall, a fact which has greatly facilitated lateral transfers between departments and divisions. As far as computerized typesetting operations are concerned, the job classification of clerical people doing this work has recently been upgraded so as to bring their pay more into line with that earned by commercial typesetters.

By comparing the number of clerical staff in the various city departments who are trained in word processing operations to the number of stenotyping-filing employees in each department, a rough measure of the extensiveness of the training process can be obtained. Overall, close to half of the most relevant occupational category has been trained up to this point. Some departments have nearly all secretarial workers trained, while others have only a few. Until recently, the slowness of training new operators has been a major factor retarding the greater use of the word processing system's capabilities. This is because training was done individually or in pairs. Beginning in March, 1981, however, the city opened a new group training centre in which up to 10 operators can be trained at a time. The backlog of departmental requests for word processing training for clerical workers is now expected to be cleared in about a year, although this forecast appears optimistic. For one thing, with the greater number of students per class, it now takes three weeks of half days rather than two weeks, in order to complete the basic training course. Eventually, however, it seems quite clear that nearly every one of the city's stenotypists will be required to possess computerized word processing skills, while most other clerical positions will require at least basic skills in computerized manipulation of numerical data and in retrieval of information from computerized central files. In other words, in the not so distant future, the vast majority of clerical workers employed by the City of Toronto will be making use of computers on a day-to-day basis, although such work will not necessarily be the central focus of their jobs.

The Uses of Word Processing in the City Clerk's Department

At the centre of the flow of words at City Hall is the Clerk's Department, and it is on this department's use of word processing that we have focussed a more detailed examination.

The City Clerk's Department receives reports from all city departments and from outside correspondents and these must be prepared for the consideration of City Council and the various council committees. After those bodies have met and considered the material presented, minutes of their meetings must be prepared for publication.

Under the system of computerized text processing, all material received by the Clerk's office from other city departments must be in electronic form, plus one paper copy for administrative purposes. Formerly 80 paper copies of each document were required, which meant that a lot of time was spent in each department copying and collating before shipping a heavy boxload of paper off to the Clerk's office. With the computer now controlling the copying operation as one sequential process repeated 80 times no collating is required and the Clerk's Department picks up the copies as they come off the city's new high speed laser printer, rather than waiting for delivery from the various departments. At numerous other points along the way -- passing through committees, back to the departments, being referred between departments -- the fact that all documents were originally delivered in electronic form has great advantages for those who process and reprocess what is basically the same material, through successive steps of correction, modification, reformatting, and editing. But it is at the end of the line, when the official minutes of council or committee meetings are finally typeset and printed, that the biggest direct financial advantage is obtained. In effect, because the complete text of each document is already stored in the computer typesetting no longer requires keying in of the text itself. Instead, only technical details such as type font, spacing, headings, and layout must be added, thus considerably shortening the amount of work to be done before printing can commence. Proofreading is now as much a question of looking for computer "glitches" as it is of checking for errors in copying from the original source documents.

Here are some other advantages of the computerized text processing operations in the Clerk's Department:

- much less retyping required when corrections are made to text already in the system;
- electronic access to and searching of records of meetings and correspondence stored on disc or tape (this part of the system is not yet living up to the high expectations held out for it initially);
- elimination of much duplicating and collating by the source department when reports are printed on the computerized laser printer;
- typesetting of the City and Metro municipal government phone book;
- typesetting as well as text editing of written reports by the other departments, as for example, the Annual Report of the Department of Public Health.

The following sections will attempt to evaluate the effect of this computerized text processing system on employee productivity, as well as the monetary loss or gain to the City Clerk's Department as a result of typesetting the council minutes in-house by computer rather than having this work done by commercial printers.

Electronic Processing of the Council Minutes

As was mentioned before, the City Clerk's office is responsible for handling an incredible volume of written communications related to the work of City Council, the Executive Committee, and the various standing and special committees of council. Although but the tip of the iceberg in terms of total workload of written communication, the official minutes of the bi-weekly council meetings are undoubtedly the most visible end-product of the department's word processing activities. Now running over 500 pages per issue, the council minutes also provide an admittedly very crude, but nonetheless available and objective indicator of the volume of official correspondence handled by the department. In the Clerk's Department subsequent to the introduction of computerized text processing, the number of pages of council minutes published has more than doubled, while total employment has increased but marginally. [See Figure 4.1 and Table 4.2].

Computerized text processing in the department was intended to pay for itself on the basis of lower costs for publishing the minutes. Although early design proposals for the computerized text processing system in the City Clerk's Department called for printing as well as typesetting to be done in-house, only the typesetting operation was in fact taken over by city employees. Recently, however, the possibility of printing the minutes in-house is being re-examined in the light of new technology now available, such as the city's new high speed laser printer.

After nearly two years of pilot projects, testing, and delays in receiving equipment, during which time the computerized text processing operation was a big money loser, the computerized typesetting part of the process became operational in mid-1977. By the following year, the savings on outside typesetting costs were more than enough to offset the accumulated losses of the previous two years, and still permit a handsome net gain to be realized. [See Figure 4.2 and Table 4.3.]

Effects on Employment Volume

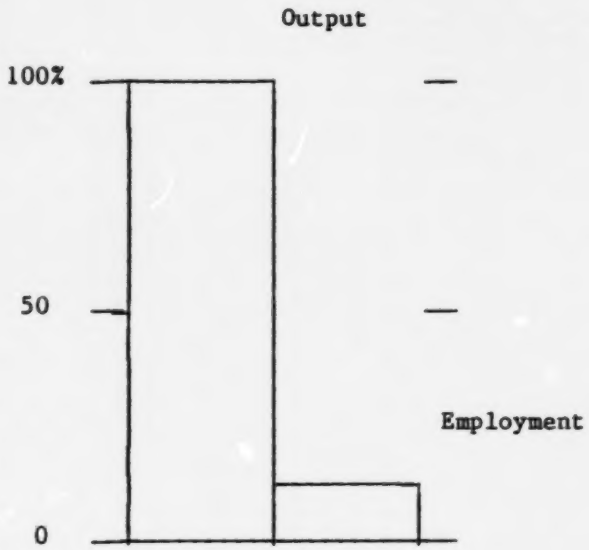
The initial direct employment effects of this operation were the addition of four people with various computer-related skills to the Clerk's Department staff. However, at the commercial printing firm which had previously done both the typesetting and printing of the council minutes, the loss of typesetting put approximately eight jobs in jeopardy. In other city departments, many weeks had to be devoted to the training of secretaries and typists in the new word processing skills.

In seeking to evaluate the net employment effects of computerized text processing in the City Clerk's Department, it is important to distinguish short-term from long-term consequences, just as it is important to differentiate internal and external effects. As was already mentioned, over the five-year period 1974-1979, the number of printed pages of council minutes produced doubled while employment increased only marginally.

It would be most interesting to be able to compare employees' subjective reactions to pre- as opposed to post-computer methods of work in their

Figure 4.1

INCREASE IN EMPLOYMENT AND OUTPUT OF COUNCIL MINUTES, CITY CLERK'S DEPARTMENT TORONTO, 1974-1979



Source: See Table 4.2.

Table 4.2

PAGES OF COUNCIL MINUTES PRODUCED AND NUMBER OF EMPLOYEES IN THE CITY CLERK'S DEPARTMENT, BEFORE AND AFTER THE INTRODUCTION OF COMPUTERIZED TEXT PROCESSING, CITY OF TORONTO, 1974-1979

Year	Total Staff[a]	Pages of Council Minutes[b]	Productivity in Pages/Employee
1974	113	7,500	66
1979	124[c]	15,000	121
1974-79	+11	+7,500	+55

Note: a. Approximately half of these are employed in sections totally unrelated to the preparation of council minutes.

b. Estimated number of final published pages.

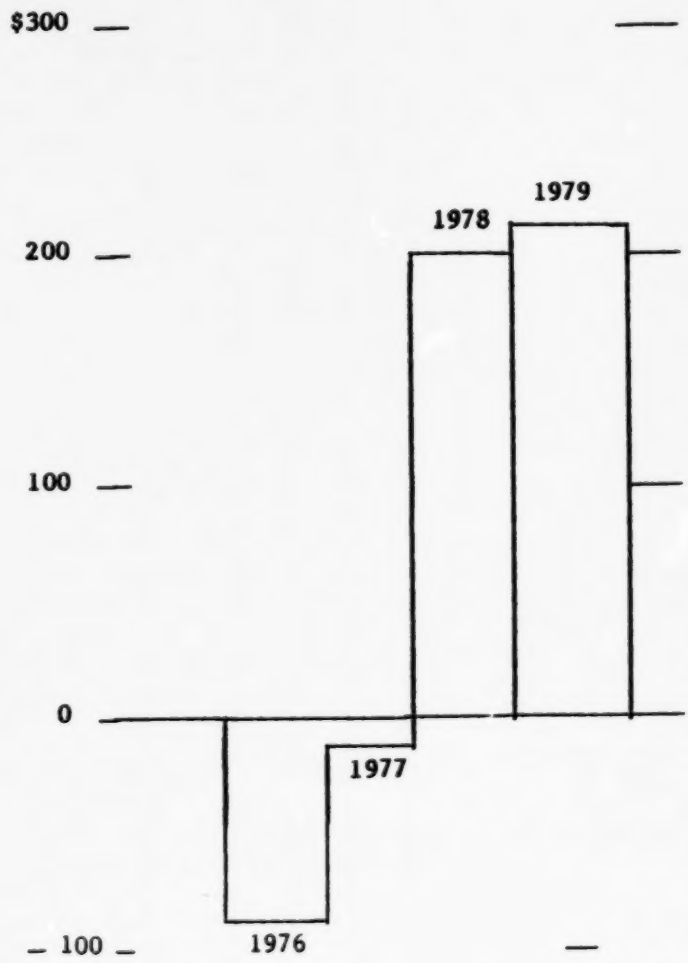
c. In order to allow comparison between the two years, only those sections which were part of the Clerk's Department in 1974 are shown. Thus the 1979 total given here excludes 7 employees in the Mayor's Office as well as 30 employees in the Public Information and Communication Section.

Source: Departmental establishment lists for February 14, 1974 and September 12, 1979.

Figure 4.2

NET LOSS OR GAIN TO CITY CLERK'S DEPARTMENT FROM COMPUTERIZED TYPESETTING OF COUNCIL MINUTES, TORONTO, 1976 - 1979

(current dollars x 1,000)



Source: See Table 4.3.

Table 4.3

NET LOSS OR GAIN TO THE CITY CLERK'S DEPARTMENT FROM COMPUTERIZED TYPESETTING OF COUNCIL MINUTES, CITY OF TORONTO, 1976-1979

Year	Additional Costs[a] Absorbed by Dept.	Savings to Dept. on Outside Typesetting	Net Gain (Loss) to Department
1976	77,067	--[b]	(77,067)
1977	221,080[c]	208,935	(12,145)
1978	165,442	375,286	209,844
1979	177,905	399,715	221,810

Note: a. Includes additional salaries, software, terminals, photocomposition equipment and film.

b. No typesetting done in-house during the first year.

c. Includes purchase of computerized phototypesetting equipment.

Source: From unpublished data supplied by the City Clerk's Department, March 1981.

departments, but it is becoming increasingly difficult to find clerical workers who can do this based on their own experience. In the Finance Department, for example, four-fifths (78%) of women employees (all of whom are classified as clerical) had ten years or less service with the city. Thus, it should not be surprising that questions relating to what work in the department was like in the days before computerization, while of some historical interest, are becoming rather distant from the current preoccupations of most employees of the department.

In the City Clerk's Department as well, although the introduction of computerized text processing occurred much more recently than did electronic data processing in the Finance Department, the situation is somewhat similar, but for different reasons. While most of the higher-level secretaries, professionals and managers began their careers in the department in the years before computerized text processing arrived (in other words, prior to 1975), the same cannot be said for lower-level clerical employees. Of approximately 15 steno-typists currently working with the text processing equipment on a day-to-day basis, only one was onstaff before computer technology was introduced. Thus, turnover among the department's lower-level clerical staff has been particularly high. However, this high turnover has not been attributable to an adverse reaction to changes in the work environment due to the introduction of new procedures and processes associated with the new technology. Rather, it reflects mobility within the organization.

In the six years since the introduction of computerized text processing, several lower clerical staff have been promoted into higher positions (such as committee secretaries) not requiring active use of their word processing skills. Many of the others have moved on to similar work in other city departments where their word processing skills have been in high demand since the pace of training new operators has, up until recently, fallen behind the increase in demand for these skills.

The following section will discuss a number of related trends and developments including the effects of turnover and attrition on the pace of technological change which can be absorbed without layoffs or firings. This will set the scene for consideration of the longer range effects of computers and microelectronics on the occupational mix of the workforce, to be discussed at the end of Chapter Five.

RELATED TRENDS AND DEVELOPMENTS

Informatics Technology and the Work Environment: Union and Management Positions

Mention has already been made of effects on education and skills levels observed after the introduction of data processing in the Finance Department and word processing in the Clerk's Department. We have also discussed changes in output, productivity, and total number of jobs which may have been associated with the introduction of computer and microelectronics-based technologies. Recently, however, more interest is being focussed on

the possible effects of informatics technology on the health of workers and on the quality of their work environment.

The possible health effects of video display terminals have been of particular concern after babies with birth defects were born to four women employees of a Toronto newspaper whose work required them to be at such terminals all day. Subsequent testing by the Ontario Ministry of Labour of the suspect equipment in the newspaper offices, as well as of a sample of terminals at city hall, revealed no measurable emissions of harmful radiation from these units. An analysis of the scientific literature by the City's Health Advocacy Unit [Elinson, 1980] also revealed no cause for alarm as far as ionizing radiation was concerned. Nevertheless, the question of possible health hazards to workers from the use of the video display terminals is still of concern at the City of Toronto. Organized labour feels that the available evidence concerning possible radiation hazards is still not entirely conclusive, and so prefers to err on the side of caution rather than risk possible long-term health consequences for its members.

Of increasing importance, however, are the effects of the rapidly expanding use of the computer and microelectronics technology on the quality of the work environment of the many employees now using the new systems on a regular basis. Some of these potential problems, as well as the possible hazards due to radiation, are discussed in a health alert bulletin issued by the Metropolitan Labour Council of Toronto (1980). In addition, a major study of the non-radiation related health effects -- such as eye strain, back problems and increased stress -- of video display terminals has been completed by the City's Health Advocacy Unit [Rosenbaum, 1981]. This report makes recommendations for changes needed to ensure greater protection for workers affected by the new technologies. [For a discussion of related experience elsewhere, see Thoreson and Maus, 1979, and Thoreson, 1979.]

Employment security for workers in the face of rapid technological change in the Canadian office environment has also become a topic of collective bargaining [Malherbe, 1980]. In the public sector organized labour's approach to these questions is discussed in a research paper by the Canadian Union of Public Employees (CUPE) national office [Stinson, 1981]. In Toronto official policy of the City Council (adopted May 26, 1980) states that no city employee shall be relieved of employment as a result of work reorganization (whether this be for technological or other administrative purposes). The policy further states that no city employee shall suffer a decrease in salary as a result of reorganization, even in cases where the employee must subsequently be placed in a position of lesser responsibility.

The second part of this policy, which concerns salary protection for employees negatively affected by reorganization, has been interpreted in practice to mean that the salary of employees in such a situation is frozen ("redcircled") at the nominal level received before reorganization. The buying power of that salary is thus allowed to erode at the current rate of inflation, effectively reducing the real wages received. The union feels that this sort of treatment is unfair to longtime city employees whose jobs

have disappeared through no fault of their own, as has happened recently in the case of keypunch operators, and that such a result is really not what was intended by Council at the time the salary protection policy was introduced.

In general, as union leaders are quick to point out, as long as technological change is seen as a purely management prerogative, not subject to negotiation or even advance notification for those who are most immediately affected, workers really have no guarantee that their interests will in fact be protected. Workers and their unions argue for representation in the planning and design stages to ensure that the implementation of change, when it occurs, will be handled in a manner beneficial to all parties. In particular, adequate lead time needs to be available for testing of proposed work arrangements, evaluation, adjustment, andretraining as necessary.

Future Prospects: Toronto

Future applications being contemplated or developed in the City of Toronto at the time of this study include the following projects:

- graphics capability to be added as a general feature of use in all systems, but particularly for draughting and cartographic uses; the impact on drawing is expected to be analogous to that of word processing on typing;

- possible movement towards smaller but powerful processing units dedicated to particular applications, such as financial; however, these units would be intercommunicating in order to improve service levels to all users without sacrificing the present high levels of systems integration; such developments would mean that the days of a single large main-frame computer for the entire city would be numbered;

- substantial upgrading of the oldest systems which were developed for earlier generations of computers and do not take full advantage of the possibilities inherent in the more modern machines currently in use or of those which may be acquired in the future;

- computer-aided dispatch for firefighters and their equipment;

- feasibility testing of in-house printing -- reviving an idea originally envisaged back in 1975 when computerized text processing was introduced to the city;

- doubling of the number of city employees trained in word processing operations, and advanced training for current users at the group training centre (which can also be used for teaching other applications packages such as for statistics, or data processing);

- personnel employment profiles based on time series data (useful for answering the sorts of questions about career advancement, dis-

placement, attrition and so forth, which were so difficult to answer with any precision based on currently available personnel data);

- additional legal applications for city solicitors;
- computerization of the operations of one of the last offices to which the terminals have not yet come -- the Committee of Adjustment, which handles requests for zoning variances, and is currently swamped with paperwork;
- much increased usage of portable remote data entry devices for field use by inspectors;
- improved text retrieval, possibly by the construction of a thesaurus of relevant terms and headings.

The backlog of programming work for tasks already identified as suitable for automation is said to be from two to five years, depending on the urgency of the development. While the lack of available computer and systems staff in relation to the work to be done is clear, this shortage is not simply due to budgetary and staff limitations, but also due to a shortage of qualified computer specialists. In spite of the evident need for their skills and of budgetary approval for the additional salaries, two positions for programmer-analysts in the Computer Services Division were vacant at the time of this study.

CHAPTER FIVE

MICROELECTRONICS AND EMPLOYMENT IN CLERICAL OCCUPATIONS: THE WIDER CONTEXT

The Municipal Administrative Environment

In focusing our study on municipal government, and by looking specifically at three lower-tier municipalities, only a partial view of the total potential uses and employment effects of microelectronics in local administration is obtained. For example, among the many other local government services not usually provided by city governments in Ontario, police forces typically make extremely heavy demands on computer resources, but are the responsibility of autonomous commissions usually having their own computer resources. Therefore, only mention in passing could be made to the extensive computer usage of the Ottawa police force. Social services are also heavy users of informatics resources, but are now usually the responsibility of regional government, and make use of the provincially organized computerized social service systems. There are also the boards of education, hydro authorities, transit commissions, and so on, not to mention local offices of senior levels of government. Each of these specialized functional uses would require a case study to do it justice which obviously falls well beyond the scope of the present work. Nevertheless, it is well to keep in mind just how limited a role the lower-tier municipalities play in the overall scheme of local administration in Ontario because the effects of microelectronics on local government employment certainly spread far beyond the relatively narrow jurisdictional confines of our city halls.

Effects of Informatics Technology on Productivity and Employment: Experience Elsewhere

The effects of informatics technology on productivity and employment in local government have come under increasingly close scrutiny in recent years [Sartore and Kraemer, 1977; Kraemer and King, 1977A, 1977B; Anderson, 1980; Davis and Walker, 1980; OECD, 1978]. In response to a 1974 survey of 2,637 civic officials in the United States [Danziger, 1978] a large majority (78%) of those surveyed indicated that computer usage for data processing pays off in terms of increased productivity. They agreed that "computers allow departments to handle a greater volume of service without corresponding increases in cost." By contrast, opinion was nearly evenly divided as to whether computer usage led to actual staffing reductions. Slightly fewer (48%) agreed than disagreed (52%) that "where they have been applied, computers have reduced the number of people necessary to perform tasks in my department."

Concerning text processing applications, a large scale survey of the actual experience of many North American public and private sector users has recently been completed [International Word Processing Association et al., 1979]. The results show that the effect of word processing on secretarial staff size varies considerably: 42 per cent of respondents reported no

change, while seven per cent reported an increase, and only 40 per cent said staff size actually decreased. These findings point out that the theoretical gains in efficiency of 100-300 per cent frequently cited in the more technically-based literature are in practice often not translated directly into workforce reductions.

Recent Trends in Employment by Occupational Category

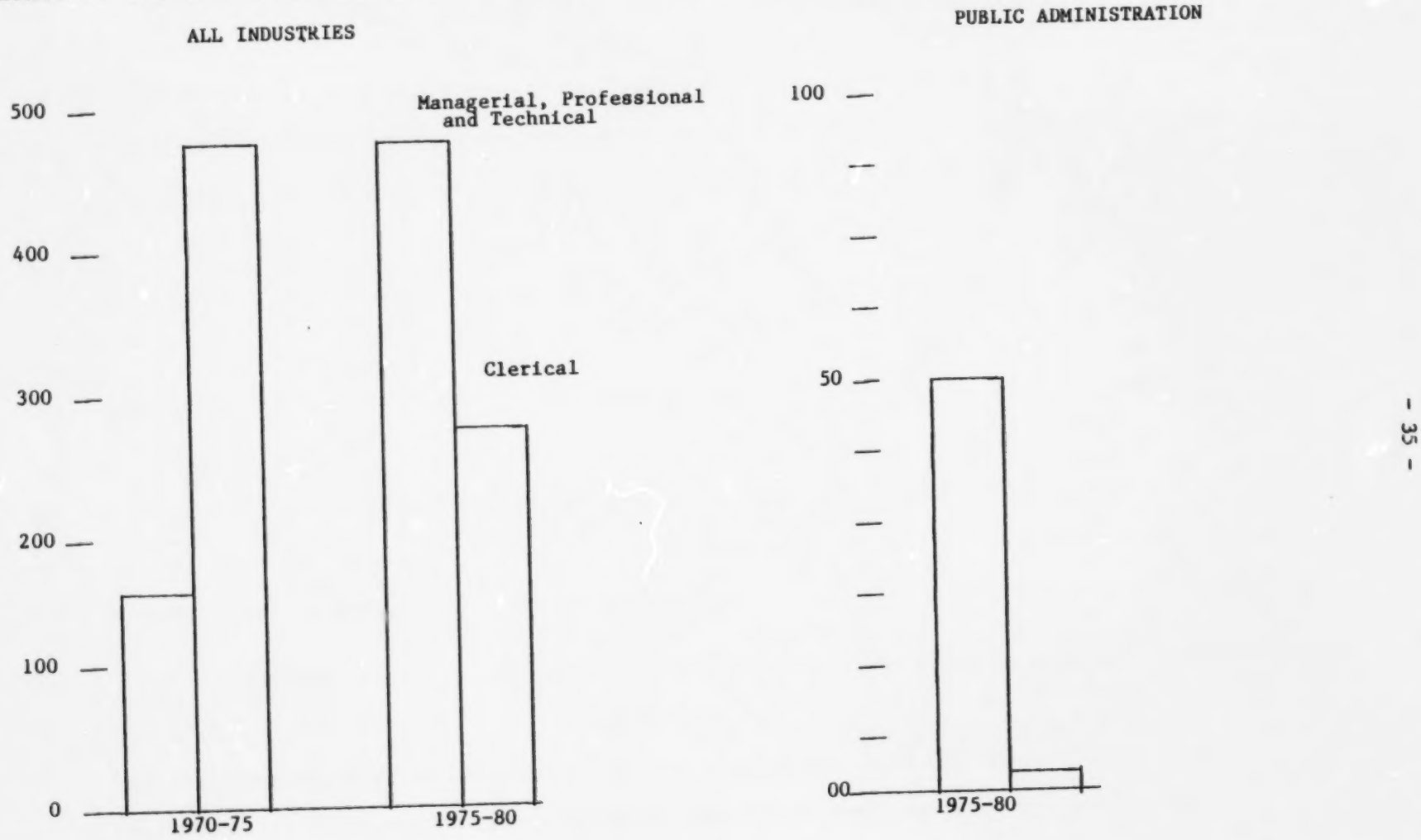
Whether technological changes or other factors were primarily responsible, data from Statistics Canada show that for workers in all branches of industry, the 1970s witnessed a complete turnaround in office employment growth patterns by occupation. As shown in Figure 5.1 and Table 5.1, during the first five years of the 1970s, the increase in clerical employment was nearly three times that of managerial, professional and technical employment, while in the last five years of the decade, managerial, professional and technical employment growth was almost twice that of clerical employment. In public administration at all levels across Canada, the turnaround was even more pronounced. Clerical employment growth in government came to a virtual halt in the second half of the 1970s. At the same time, however, government employment for managerial, technical and professional workers increased by 50,000 [see Figure 5.1 and Table 5.2].

In terms of future employment prospects for women, these trends are particularly significant. In the city of Toronto, for example, two-thirds of all female municipal employees are currently to be found in the various clerical occupations, working as receptionists, typists, file clerks, bookkeepers and so forth.

Although the labour force participation rates of women are predicted to continue to increase rapidly throughout the 1980s, it now seems highly unlikely that clerical employment opportunities for women will increase anywhere nearly as rapidly. The obvious implication, already pointed out so clearly by Menzies [1981] in respect to private sector employment, is that women's occupational orientation and training will have to undergo a major realignment if high levels of clerical unemployment are to be avoided in the coming years.

Figure 5.1

GROWTH OF OFFICE EMPLOYMENT BY OCCUPATIONAL CATEGORY CANADA, 1970-75 AND 1975-80 (in thousands)



Source: See Table 5.1 and 5.2

Table 5.1

EMPLOYMENT IN MANAGERIAL, PROFESSIONAL, AND TECHNICAL, AS WELL AS IN CLERICAL AND ALL OCCUPATIONAL CATEGORIES, FOR ALL INDUSTRIES, CANADA, 1970, 1975, 1980

(x 1,000)

Years	Managerial, Professional and Technical	Clerical	All Occupations
1980	2440	1871	10655
1975	2008	1628	9284
1970	1856	1168	7879
1975-80	+432	+243	+1371
1970-75	+152	+460	+1405
1975-80	+21.5%	+14.9%	+14.8%
1970-75	+8.2%	+39.4%	+17.8%

Note: Employment figures are based on Labour Force Survey data and refer to all classes of workers.

Source: Statistics Canada, (1981, Table 78; 1979, Table 17; 1972, Table 8).

Comment: Occupational data not published by sex for 1970. In the period 1975-1980, however, virtually all of clerical job growth was accounted for by women; whereas managerial, professional and technical job growth went equally to men and women.

Table 5.2

EMPLOYMENT IN PUBLIC ADMINISTRATION, BY OCCUPATIONAL CATEGORY AND SEX, CANADA, 1975 AND 1980 (x 1,000)

	Managerial and Professional			Clerical			Other			Total		
Years	T	M	F	T	M	F	T	M	F	T	M	F
1975	229	186	43	205	55	150	231	213	17	665	454	210
1980	274	206	68	206	51	155	260	230	29	740	487	252
1975-80	+50	+20	+25	+1	-4	+5	+29	+17	+12	+75	+33	+42
1975-80	+21.8%	+10.8%	+58.1%	+0.5%	-7.2%	+3.3%	+12.6%	+8.0%	+70.6%	11.3%	7.3%	+20%

Note: Annual averages based on new labour force survey.

Source: From unpublished tabulations supplied by the Labour Force Survey Division, Statistics Canada, March, 1981.

CHAPTER SIX

SUMMARY OF FINDINGS

Experience to Date

The effects of microelectronics and computers on municipal employment were studied in three major Ontario cities. It was found that the use of informatics technologies aided productivity, and at times led to substantial cost reductions for certain operations. Turnaround time for completion of tasks was also improved in most cases. In the departments affected by automation, the number of employees first increased slightly, then levelled off and remained stable later despite sometimes quite substantial increases in workload handled. Displacement rather than unemployment was the rule for municipal employees in the departments which adopted the new technologies. Redundant jobs were usually eliminated by attrition or lateral transfer of affected employees. Overtime work, casual employment, and contracting out were reduced, but no firings of permanent employees were reported. Effects on occupation and skills composition of employment differed from department to department, according to the character of the new application and the way in which it was implemented.

In financial operations, which were transformed by the early phases of computerization, a pattern of employment discontinuity was noted, with losses due to attrition in the lower clerical ranks. Also there was frequently an upgrading of positions which were filled by more highly skilled replacements recruited from outside. The result of this process raised the average educational level of the organization, but more often than not for the individuals within the organization it meant a widening of the skills gap between the diminishing number of lower skilled clerical jobs and the increasing number of highly skilled accounting and other analytical positions.

In municipal word processing operations, the pattern has been one of retraining of existing personnel and maintenance or even improvement of individual career path continuity over time. A slight upgrading effect on job qualifications has occurred, but this has been felt more in terms of increased marketability of those possessing the required skills rather than in terms of higher salaries. In the case of clerical employees trained to do computerized typesetting and photocomposition, however, higher wages are now paid in order to bring their compensation more into line with that of the linotype operators who formerly did that work. In marked contrast to what has sometimes been observed among private sector users of this technology, in the three city governments studied wholesale restructuring of typing and secretarial jobs to maximize machine utilization has not taken place, nor have personnel reductions in these occupations been noted.

As a general rule, municipal data entry operations, which were centralized into large, specialized keypunching sections of the newly formed data processing divisions in the early phases of computerization, are now being decentralized back to their departments of origin. In addition, wherever possible, data is captured electronically at its source (or as close to it

as is practical), thereby reducing or eliminating former intermediate steps such as transferring data from work sheet to punched cards or disc.

The application of this same general principle to municipal word processing operations would necessitate a much greater diffusion of this technology than is presently contemplated. It would also imply a breaking down, or at least softening, of barriers to greater systems usage based mainly on traditional occupational stereotypes. Capturing the information (in this case words rather than numerical data) closer to its source would require professionals and managers, as well as secretaries, to possess the training and equipment necessary to input and manipulate text in electronic form. In the three cities studied, this is already beginning to happen on an informal basis, but not to any great extent as yet.

In respect to the direct employment effects of the use of microelectronics and computers, union interest is focused on the protection of jobs, salaries and working conditions of current membership. To this end, workers and their representatives are beginning to demand not just notification of changes underway, but also the opportunity to have input during the planning and design stages so that adequate lead time will be available for any adjustments necessary.

Effects on the quality of the work environment of municipal employees, while not insignificant, are difficult to evaluate comprehensively. Nevertheless, it is clear that health concerns such as those related to possible birth defects and vision problems are subjects preoccupying more than a few city employees and their union representatives who feel that the evidence for or against the hazards of video display terminals (VDTs) is still inconclusive. Pending satisfactory resolution of these questions in a convincing manner such fears will inevitably dampen employee and union enthusiasm for the new technology -- quite apart from any other fears they might have regarding its effect on the quantity and quality of future employment opportunities.

Outlook for the Future

The outlook for future developments in the next five years depends to a great extent on the overall approach to informatics. Because of universally severe limitations on municipal staff and budget levels, future plans necessarily tend to be incremental rather than revolutionary. Each of the three cities studied had acquired a new main computer within the preceding year or two, and appeared considerably more concerned with making better use of existing equipment than with acquiring yet more hardware. Lengthy programming backlogs (up to three years) are typical, and in at least one case, a shortage of qualified personnel to fill vacant positions was cited as a factor retarding development work.

It should be emphasized that city officials interviewed for this report spoke of their future plans in very concrete terms. Generally speaking, their plans are limited to describing how they intend to make greater use of existing technologies (catching up with the capabilities of what is already available) rather than speculating about the possible effects of

technological developments yet to come. Such an approach, however understandable, clearly tends to underestimate the magnitude of changes already on the horizon. Thus, the most probable scenario for the future may well turn out to be somewhat more dramatic than what seems to be indicated by any of their current plans.

Planned or seriously contemplated future developments involving greater use of microelectronics and computers in the three municipalities studied include the following developments:

- extension of word processing capability throughout the city hall, and making greater use of the communications capabilities of computers and word processors, as well as eventual development of in-house printing in at least one case; and greater use of these systems for text retrieval as storage capacity and searching power increase;

- capture of data in electronic form nearer to its source, through the truncation of intermediate steps on paper as terminals are placed closer to the "front line" workers who generate or collect the information;

- redesign of now obsolete early data processing systems, particularly in financial areas, with the new systems possibly to be based on dedicated, small but powerful main-frames or minicomputers connected to the city network;

- development of a broad range of new systems for operations previously untouched by computerization, such as graphics and mapping (linked to the various other existing centralized data banks), and computer-aided dispatch and information retrieval for fire department use, to name only a few of the many new implementations under active consideration.

In the years ahead, many of the occupations which have up to now remained relatively removed from earlier phases of informatics are expected to be brought into much closer contact with the new technologies. Besides nearly all clerical and secretarial staff, workers in occupations such as building inspection, draughting, and fire protection may become first hand users as well as recipients of electronic information processing based on microelectronics and computer technology.

In conclusion, on the basis of the present case studies, there seems to be little need to fear that these new applications, any more than the old applications, will in fact result in massive numbers of direct job losses in municipal administration. However, the prospects of indirect job losses and of lack of future employment growth is another question entirely. It is nearly universally agreed that in the absence of informatics technologies, municipal employment would have to expand significantly over observed levels in order just to keep up with increasing demands.

REFERENCES CITED

ANDERSON, Roger. 1980. "The New Technology on Tameside: How Will the Silicon Chip Affect Employment?" Municipal Review, Vol. 51, No. 604 (June), pp. 60-61. (Association of Metropolitan Authorities.)

CITY OF OSHAWA. 1981. Municipal Adminstration - 1980. Oshawa: Treasury and Finance Department, City of Oshawa.

CITY OF OSHAWA. 1976. Civic Administration - 1975. Oshawa: Treasury and Finance Department, City of Oshawa.

CITY OF OSHAWA. 1971. Civic Administration - 1970. Oshawa: Treasury and Finance Department, City of Oshawa.

CITY OF TORONTO. 1980a. Civic Organization. Toronto: Management Services Department, City of Toronto.

CITY OF TORONTO. 1980b. Computerized Text Processing, Department of the City Clerk, Toronto City Hall. Toronto: Department of the City Clerk, City of Toronto, May. 20 p.

CITY OF TORONTO. 1980c. Equal Opportunity Annual Review - 1979. Toronto: Management Services Department, City of Toronto. 150 p.

DANZIGER, James N. 1979. "Technology and Productivity: A Contingency Analysis of Computers in Local Government." Administration and Society, Vol. II, No. 2 (August), pp.144-171.

DAVIS, J.R., and WALKER, P.A. 1980. "The Use of Computers in Australian Local Government." Computers, Environment and Urban Systems, Vol. 5, No. 1/2 (1980), pp. 55-80.

ELINSON, Lynn, with Linda ROSENBAUM, Trevor HANCOCK, and Gerald CAPLAN. 1980. Health Effects of Video Display Terminals: A Report of the Health Advocacy Unit. Toronto: Department of Public Health, City of Toronto. July 29. 14 p.

KRAEMER, Kenneth L., and KING, John Leslie. 1977a. Computers and Local Government: Volume 1, A Manager's Guide. Praeger Special Studies in U.S. Economic, Social and Political Issues. New York: Praeger Publishers. 110 p.

KRAEMER, Kenneth L. and KING, John Leslie (eds.). 1977b. Computers and Local Government: Volume 2, A Review of the Research. Praeger Special Studies in U.S. Economic, Social and Political Issues. New York, London: Praeger Publishers. 349 p.

LABOUR COUNCIL OF METROPOLITAN TORONTO. 1980. "Video Display Terminals: Hazard Inventory." Health Alert (The Health and Safety Newsletter of the Labour Council of Metropolitan Toronto), Volume 4, Nos. 3 and 4 (Sept.-Oct.), pp. 1-6.

MALHERBE, Cecile. 1980. "Technological Change: Planning for the Future." The Civil Service Review (Public Service Alliance of Canada), Vol. 53, No. 4 (December), pp. 3-7.

MENZIES, Heather. 1981. Women and the Chip: Case Studies in the Effects of Informatics on Employment in Canada. Montreal: Institute for Research on Public Policy. 98 p.

MINISTRY OF INTERGOVERNMENTAL AFFAIRS. 1980. Municipal Directory - 1980. Local Government Division. Toronto: Queen's Printer for Ontario.

ORGANIZATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD). 1981. Microelectronics, Productivity and Employment. Information, Computer and Communications Policy (ICCP), No. 5. Paris, OECD. 290 p.

ORGANIZATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD). 1978. Local Government and Information Technology. Informatics Studies, No. 12. Paris: OECD. 322 p.

PEITCHINIS, S.D. 1981. The Employment Implications of Computers and Telecommunications Technology. Calgary, Alberta, Department of Economics, University of Calgary. April.

PRICE WATERHOUSE ASSOCIATES. 1976. The Organization of Administrative Support Services in Metropolitan Toronto. A Study for the Royal Commission on Metropolitan Toronto. Toronto: The Royal Commission on Metropolitan Toronto, October 26. 150 p.

RADA, Juan. 1980. The Impact of Micro-electronics: A Tentative Appraisal of Information Technology. Geneva: International Labour Organization (ILO).

RAHN, R.J. 1980. Chipping Away at Labour: Microelectronics and Employment in Canada. A simulation model. Montreal: Institute for Research on Public Policy, June. 14 p.

ROSENBAUM, Linda. 1981. Health Effects of Video Display Terminals: The Non-Radiation Problems. A Report by the Health Advocacy Unit. Toronto: Department of Public Health, City of Toronto. April. 30 p.

SARTORE, Annabelle, and KRAEMER, Kenneth L. 1977. "Part III: Research on Impacts of Computers on Local Government Personnel and Organization", pp. 129-189 (Chapters 9-13 incl.). In Kenneth L. Kraemer and John Leslie King (eds.), Computers and Local Government: Volume 2, A Review of the Research. Praeger Special Studies in U.S. Economic, Social and Political Issues. New York: Praeger.

SINCLAIR, P.J.N. 1981. "When Will Technical Progress Destroy Jobs?" Oxford Economic Papers, Vol. 33, No. 1 (March), pp. 1-18.

STATISTICS CANADA. 1981. The Labour Force - December 1980. Catalogue No. 71-001. Ottawa: Ministry of Industry, Trade and Commerce.

STATISTICS CANADA. 1979. Labour Force Annual Averages, 1975-1978. Catalogue No. 71-529. Ottawa: Ministry of Industry, Trade and Commerce.

STATISTICS CANADA. 1972. The Labour Force - December 1971. Catalogue No. 71-001. Ottawa: Information Canada.

STEEN, Dennis F. (Project leader). 1980. Using Computers: A Guide for Municipalities in Ontario. A Management Advisory Publication, Toronto: Municipal Administration Branch, Ministry of Intergovernmental Affairs, March. 237 p.

STINSON, Jane. 1981. Technological Change and Working Women. Prepared for the Organized Working Women (OWW) Conference on Women and Employment. Ottawa: Research Department, Canadian Union of Public Employees. February. 37 p.

THORESEN, Kari. 1979. "Working Conditions in the Computerized Office." ("A somewhat more detailed presentation of the first part of the Thoresen and Maus article in EURO-IFIP 79".) Oslo, Norwegian Computing Center. 13 p.

THORESEN, Kari, and MAUS, Arne. 1979. "Technological Unemployment and Working Conditions in the Computerized Office - Two Problem Areas for Trade Unions." EURO-IFIP 79 (North Holland Publishing Co.), pp. 543-548.

ZEMAN, Z.P. (Project leader). 1979. The Impacts of Computer/Communications on Employment in Canada: An Overview of Current OECD Debates. Report prepared for the Telecommunications Economic Branch, Department of Communications, Ottawa. Montreal: Futures Studies Program, Institute for Research on Public Policy. November.